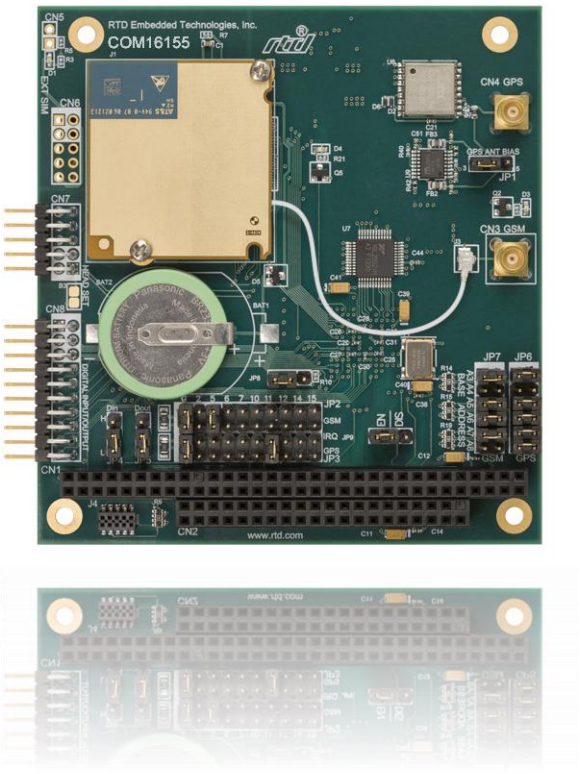
COM16155ER/COM16155RER

GSM/GPRS Modem and GPS
PCI/104 Module

User's Manual

BDM-610020119 Rev. C



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DESIGNED AND MADE IN THE UNITED STATES ™
AS9100
ISO 9001

Revision History

Rev A	Initial Release
Rev B	Corrected description of Triorail Module as Tri-Band instead of Quad-Band Corrected SIM-Card Reader section title
Rev C	Fixed default factory settings of GPS and GSM Base Address Jumpers in Table 7

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1 Introduction

1.1 Product Overview

The COM16155 is designed to provide quad-band GSM and GPRS with global positioning system (GPS) for PCI/104 based systems. Included on the COM16155 are a Cinterion MC55i-W quad band GSM cellular modem and a Linx RXM-GNSS-TM GPS Receiver module. The COM16155 has an ISA UART chip that permits communication with serial port on the GSM as well as the serial port on the GPS receiver module over the PCI/104 bus without using other serial ports in the PC/104 system. The GSM module supports an enhanced AT command set and the GPS supports National Marine Electronics Association (NMEA-0183 ver. 4.10) messages.

The COM16155R uses the Triorail Tri-band GSM cellular modem instead of the Cinterion MC55i-W for railroad applications.

1.2 Board Features

- Direct connections to the GSM module
- GSM module
  - GSM 850/900/1800/1900 MHz (COM16155)
  - GSM-R 900/1800/1900 MHz (COM16155R)
  - GPRS Multislot Class 10
  - AT command set
  - SMS
  - Fax
- Linx RXM-GNSS-TM GPS engine
  - L1 1575.42MHz, C/A code
  - 33-channel satellite tracking
  - Position accuracy: 2.5m
  - Time accuracy of ±11ns
  - 1Hz update rate (configurable up to 10Hz)
  - Tracking sensitivity down to -164 dBm
  - Protocol: NMEA-0183 ver 4.10
  - Constellation System Support:
    - GPS
    - GLONASS
    - GALILEO
    - QZSS
  - DGPS support:
    - (SBAS) Satellite-Based Augmentation System
    - (RTCM) Radio Technical Commission for Maritime Services
    - (WAAS) Wide-Area Augmentation System
    - (EGNOS) European Geo-Stationary Navigation System
    - (MSAS) MTSAT Satellite-Based Augmentation System
    - (GAGAN) GPS-Aided Geo-Augmented Navigation
- Standard 16C550 UART Interface
  - Compatible with all modern operating systems.
  - Jumper-selectable Base Address and IRQ
  - Optional 1 PPS on carrier-detect
  - TX and RX only, no flow control or handshaking required
- Digital I/O
  - 16 bit-programmable Digital I/O

- Optional 1PPS on DIO0
- PCI/104 compliant

1.3 Ordering Information

The COM16155 is available in the following options:

Table 1: Ordering Options

Part Number	Description
COM16155ER-1	PC/104 Cellular Modem Module (on-board SIM-card reader)
COM16155ER-2	PCI/104 Cellular Modem Module (external SIM-card reader)
COM16155RER-1	PC/104 Cellular Modem Module (on-board SIM-card reader)
COM16155RER-2	PCI/104 Cellular Modem Module (external SIM-card reader)
IDAN-COM16155ERS	PC/104 Cellular Modem IDAN Module
IDAN-COM16155RERS	PC/104 Cellular Modem IDAN Module

Note: Throughout this document, COM16155 refers to both the COM16155 and COM16155R unless otherwise noted

The Intelligent Data Acquisition Node (IDAN™) building block can be used in just about any combination with other IDAN building blocks to create a simple but rugged 104™ stack. This module can also be incorporated in a custom-built RTD HiDAN™ or HiDANplus High Reliability Intelligent Data Acquisition Node. Contact RTD sales for more information on our high reliability systems.

1.4 Contact Information

1.4.1 Sales Support

For sales inquiries, you can contact RTD Embedded Technologies sales via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: sales@rtd.com

1.4.2 Technical Support

If you are having problems with you system, please try the steps in the Troubleshooting section of this manual.

For help with this product, or any other product made by RTD, you can contact RTD Embedded Technologies technical support via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: techsupport@rtd.com

2 Specifications

2.1 Operating Conditions

Table 2: Operating Conditions

Symbol	Parameter	Test Condition	Min	Max	Unit
V_{cc5}	5V Supply Voltage		4.75	5.25	V
V_{cc3}	3.3V Supply Voltage		n/a	n/a	V
V_{cc12}	12V Supply Voltage		n/a	n/a	V
T_a	Operating Temperature		-30	+70	C
T_s	Storage Temperature		-40	+85	C
RH	Relative Humidity	Non-Condensing	0	90%	%
MTBF	Mean Time Before Failure	Telcordia Issue 2 30°C, Ground benign, controlled		TBD	Hours

2.2 Electrical Characteristics

Table 3: Electrical Characteristics

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
P	Power Consumption	V_{cc5} = 5.0V		TBD		W
I_{cc}	5V Input Supply Current	Active		TBD		mA
Digital I/O						
V_{IH}	Input High Voltage	CN7	2.0		5.5	V
V_{IL}	Input Low Voltage	CN7	-0		0.8	V
V_{OH}	Output High Voltage	I_O = -4mA CN7	2.4		3.3	V
V_{OL}	Output Low Voltage	I_O = 8mA CN7	0		0.4	V
	5V Output	CN7			200	mA
	Pull-up/Pull-down				10K	Ω

3 Board Connection

3.1 Board Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your board in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the board at the edges, and do not touch the components or connectors. Handle the board in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

3.2 Physical Characteristics

- Weight: Approximately 80 g (0.18 lbs.)
- Dimensions: 90.17 mm L x 95.89 mm W (3.550 in L x 3.775 in W)

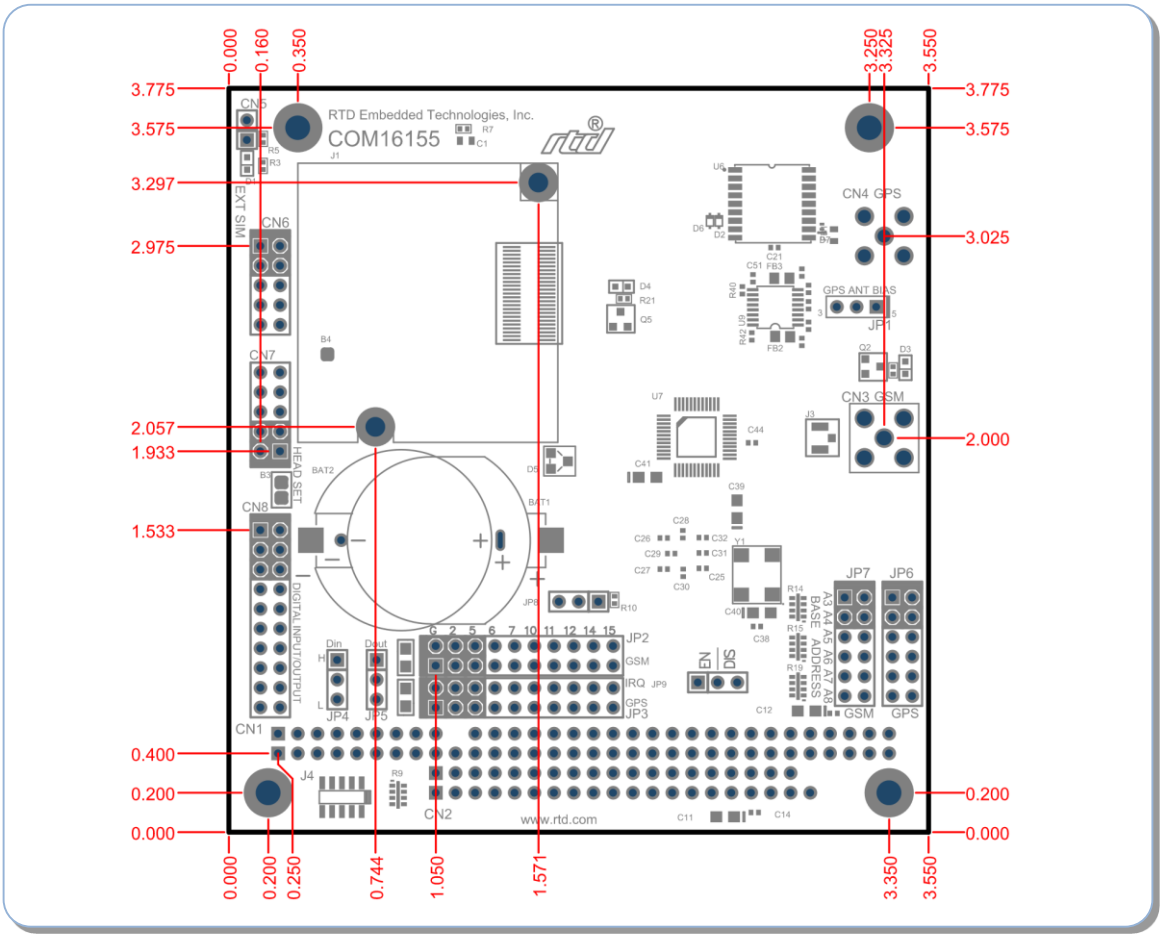


Figure 1: Board Dimensions

3.3 Connectors and Jumpers

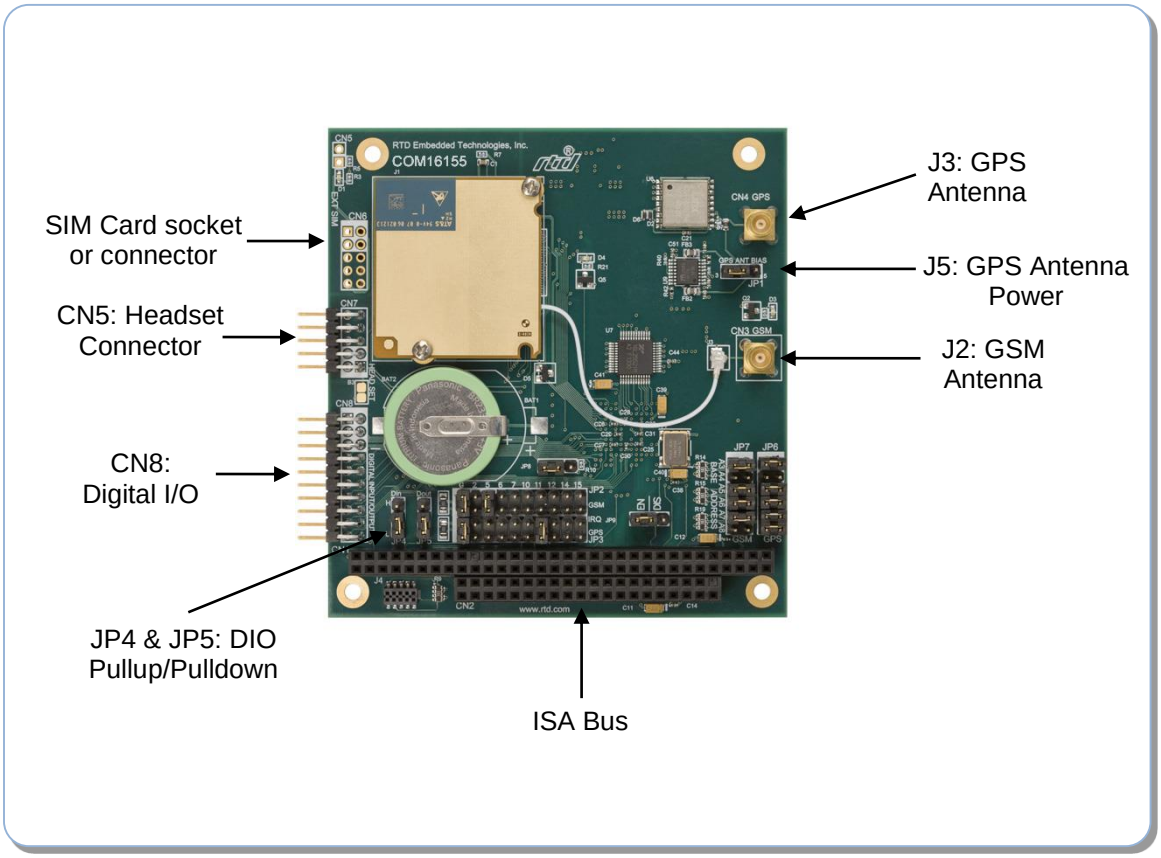


Figure 2: Board Connections

3.3.1 External I/O Connectors

CN8: Digital I/O Connector

The COM16155 offers 16 bit-programmable digital I/O lines. These can be pulled high or low through 10KΩ resistors using JP4 to control bits 0 – 7 and JP5 to control bits 8 – 15

Table 4: CN7 Digital I/O Pin Assignments

DIO0	2	1	GND
DIO2	4	3	DIO1
DIO4	6	5	DIO3
DIO6	8	7	DIO5
+5V	10	9	DIO7
DIO8	12	11	GND
DIO10	14	13	DIO9
DIO12	16	15	DIO11
DIO14	18	17	DIO13
+5V	20	19	DIO15

CN6: SIM Module/Connector

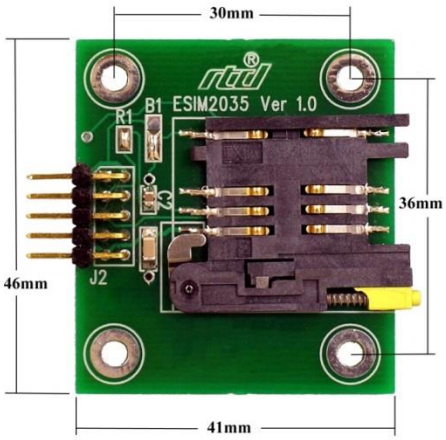
The COM16155 can use either an onboard SIM module or an external SIM connected through a cable. The COM16155-1 uses an on-board SIM module and will not have CN4 installed. The COM16155-2 uses an external SIM module. The pinout of the external connector CN6 is shown below.

Table 5: CN6 SIM Pin Assignment

Vcc	2	1	GND
GND	4	3	Reset
GND	6	5	I/O
Card Detect	8	7	CLK
GND	10	9	Vcc

The figure below shows a picture of the external SIM card interface board.

Figure 3: ESIM2035 Board

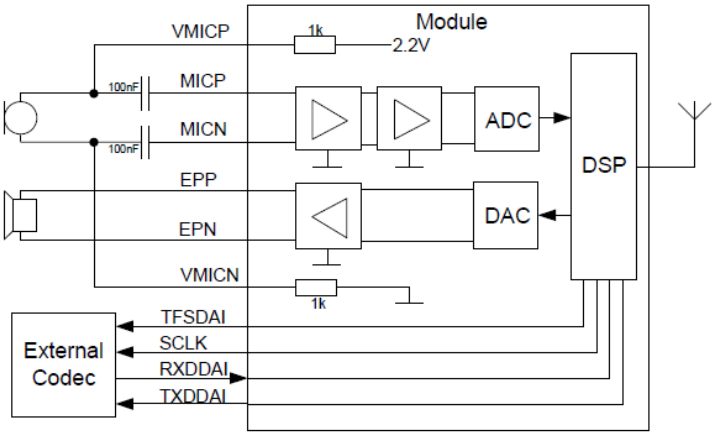


CN7: GSM Headset Connector

The COM16155 Headset connector is used to connect a headset to the GSM module for voice operation. The pin-out of the external connector CN5 is shown below.

Table 6: CN7 GSM Headset Pin Assignment

MICP	2	1	GND
EPP	4	3	MICN
VMICP	6	5	EPN
Reserved	8	7	VMICN
GND	10	9	Reserved



3.3.2 JUMPERS

The following sections describe the jumper configuration options available on the COM16155. The default factory jumper settings are listed in the following table:

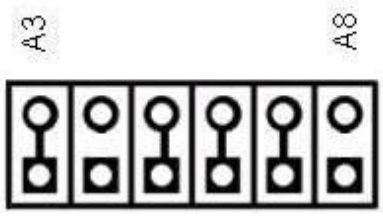
Table 7: Jumper Settings

Jumper	Description	Jumper Settings	Default Factory Setting
JP1	GPS Active Antenna Power	1-2: +5.0V 2-3: +3.3V Open for passive antennas	1-2
JP2	GSM Interrupt Jumper	Set GSM Interrupt	5 and G
JP3	GSP Interrupt Jumper	Set GPS Interrupt	11 and G
JP4	Pull-up or Pull-down for DIO0-7	1-2: Pull-up 2-3: Pull-down No connect – Neither	2-3
JP5	Pull-up or Pull-down for DIO8-15	1-2: Pull-up 2-3: Pull-down No connect – Neither	2-3
JP6	GPS Base Address Jumper	Sets GPS Address	3E8
JP7	GSM Base Address Jumper	Sets GSM Address	2E8
JP8	COM16155/COM17045 Mode	1-2: COM17045 Compatible 2-3: COM16155	2-3
JP9	1PPS on UART carrier detect (COM16155 mode only)	1-2: Enables 1PPS on UART CD 2-3: Disable 1PPS on UART CD	2-3

JP6 & JP7: Base Address Jumpers

The base address selection jumpers (A3 through A8) allow you to set the base address of the first UART that connects to the GPS module and the second UART that connects to the GSM module. Any software that accesses the board will do so through reads and writes to the I/O address set by the jumpers. To function properly, the I/O address the software is expecting must match the base address set by the jumpers.

As shown in the figure below, A3 is located at the left end of the jumper block, while A8 is located at the right end:



The table on the following pages shows the possible base address settings for the COM16155. All base addresses are in hexadecimal. An 'X' indicates a closed jumper, while an empty cell indicates an open jumper.

Base Address (Hexadecimal)	Jumpers					
	A8	A7	A6	A5	A4	A3
200						
208						X
210					X	
218					X	X
220				X		
228				X		X
230				X	X	
238				X	X	X
240			X			
248			X			X
250			X		X	

Base Address (Hexadecimal)	Jumpers					
	A8	A7	A6	A5	A4	A3
258			X		X	X
260			X	X		
268			X	X		X
270			X	X	X	
278			X	X	X	X
280		X				
288		X				X
290		X			X	
298		X			X	X
2A0		X		X		
2A8		X		X		X
2B0		X		X	X	
2B8		X		X	X	X
2C0		X	X			
2C8		X	X			X
2D0		X	X		X	
2D8		X	X		X	X
2E0		X	X	X		
2E8		**X**	**X**	**X**		**X**
2F0		X	X	X	X	
2F8		X	X	X	X	X
300	X					
308	X					X
310	X				X	
318	X				X	X
320	X			X		
328	X			X		X
330	X			X	X	
338	X			X	X	X
340	X		X			
348	X		X			X
350	X		X		X	
358	X		X		X	X
360	X		X	X		
368	X		X	X		X
370	X		X	X	X	
378	X		X	X	X	X
380	X	X				
388	X	X				X
390	X	X			X	
398	X	X			X	X
3A0	X	X		X		
3A8	X	X		X		X
3B0	X	X		X	X	
3B8	X	X		X	X	X
3C0	X	X	X			
3C8	X	X	X			X
3D0	X	X	X		X	
3D8	X	X	X		X	X
3E0	X	X	X	X		
3E8	**X**	**X**	**X**	**X**		**X**
3F0	X	X	X	X	X	
3F8	X	X	X	X	X	X

By default, the COM16155 comes configured with a base address of 0x3E8 for the GPS UART and 0x2E8 for the GSM UART.

When selecting a base address for the COM16155, please observe the following guidelines:

- Every device in your PC/104 system must have a unique base address! When selecting a base address for the COM16155, make certain that it does not conflict with any other devices.
- Base addresses 0x3F8 and 0x2F8 are typically used by serial ports COM1 and COM2, respectively. If you wish to use one of those base addresses, you will need to disable any conflicting serial port.
- Some operating systems expect UART devices to be located at the standard serial port base addresses (0x3F8, 0x2F8, 0x3E8, and 0x2E8). Setting your COM16155 to one of these addresses can make system setup and configuration easier.

JP3: GPS Interrupt Jumper

The IRQ selection jumpers allow you to set the IRQ used by the serial port UART of the COM16155. The COM16155 can be configured for any one of the following IRQs: 2, 5, 6, 7, 10, 11, 12, 14, or 15. The IRQ can be set by closing the appropriately labeled jumper on the board.

The UART's carrier detect signal, which is driven by the GPS 1 PPS, can be an interrupt source.

Default GSM Setting: IRQ 5 and G Jumper closed

Default GPS Setting: IRQ 11 and G Jumper closed

Note: Typically IRQs cannot be shared; although there are some special cases (see "The G Jumper" later in this document). In general, the IRQ you select should not be used by any other devices in your system.

Reserved IRQs

Some of the IRQ choices on the COM16155 may already be used by your CPU's onboard peripherals. Some commonly-used IRQs are:

- IRQ 2/9 is used by some VGA controllers.
- IRQ 5 or 7 may be used by the CPU's parallel port. Check your CPU's configuration to avoid a conflict.
- IRQ 12 is used by the PS/2 mouse. To use this IRQ, you will need to remove the PS/2 mouse from the system. Some CPUs also require a BIOS setting to disable the PS/2 mouse controller.
- IRQ 14 is used by the primary IDE controller. To use this IRQ, you will need to disable the primary IDE controller.
- IRQ 15 is used by the secondary IDE controller. To use this IRQ, you will need to disable the secondary IDE controller.

The G Jumper

The COM16155 supports shared interrupts as defined by the PC/104 specification. This sharing is accomplished via the G jumper, which is located adjacent to the IRQ jumpers. The G jumper installs a 1KΩ resistor to pull the signal to the low state, allowing an interrupt to drive the signal high. To share interrupts, configure the devices for the same IRQ, then close the G jumper on one (and only one) of the devices.

When using interrupt sharing, consider the following guidelines:

- An interrupt can only be shared if all devices on the IRQ support it. If you have two sharing and one non-sharing device on the same IRQ, it will not work.
- To share interrupts, the system's drivers and operating system must support it. The Interrupt Service routines must be written to check all devices on an IRQ when the interrupt is detected. Many popular operating systems do not support interrupt sharing for ISA devices.

Note: If you are not sharing interrupts, make sure you leave the COM16155's G jumper closed!

3.3.3 SOLDER BLOB JUMPERS

All solder blob jumpers are reserved for factory use and should not be changed.

3.3.4 LED INDICATORS

D1 – SIM card Power

On when the SIM card is being powered from the cellular module

D3 – 1 PPS

Provides 1 PPS to LED, begins to flash once GPS has satellite fix.

D4 – GSM STATUS Signal

The GSM AT^SSYNC command serves to configure the STATUS pin of the application interface. The pin can either be used to indicate the current consumption in a transmit burst (default setting) or to drive a status LED connected to the pin. See the AT^SSYNC command for details.

3.4 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the PC/104 system or stack.
3. Select and install stand-offs to properly position the module on the stack.
4. Remove the module from its anti-static bag.
5. Check that pins of the bus connector are properly positioned.
6. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
7. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
8. Gently and evenly press the module onto the PC/104 stack.
9. If any boards are to be stacked above this module, install them.
10. Attach any necessary cables to the PC/104 stack.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

NOTE: When using under Windows, the GPS may be incorrectly detected as a Serial Mouse, causing erratic mouse cursor behavior. This issue has been documented by Microsoft. For more information, refer to Microsoft Knowledge Base Article 283063.

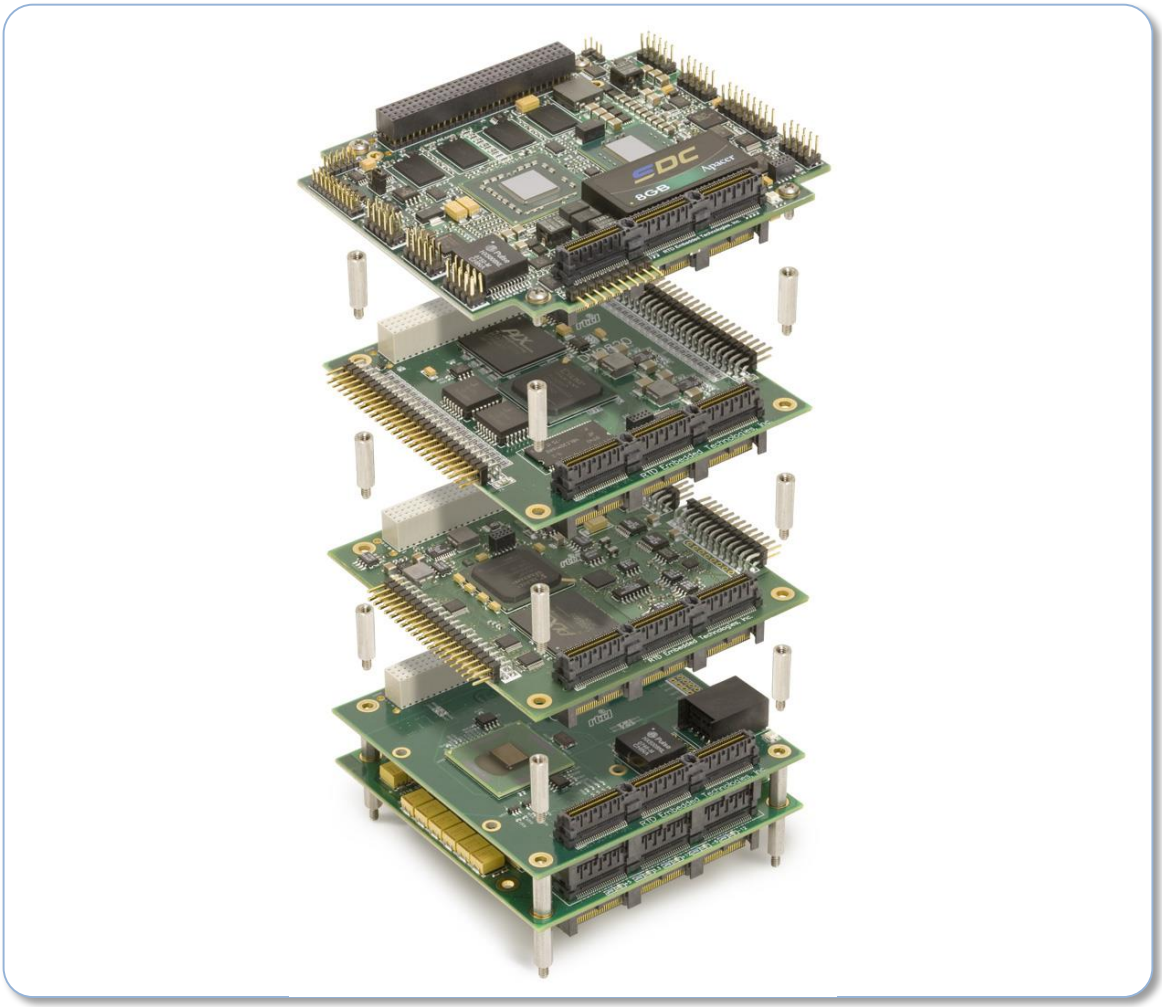


Figure 4: Example 104™ Stack

4 IDAN Connections

4.1 Module Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your module in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the module by the aluminum enclosure, and do not touch the components or connectors. Handle the module in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

4.2 Physical Characteristics

- Weight: Approximately 0.21 Kg (0.46 lbs.)
- Dimensions: 151.972 mm L x 129.978 mm W x 16.993 mm H (5.983 in L x 5.117 in W x 0.669 in H)

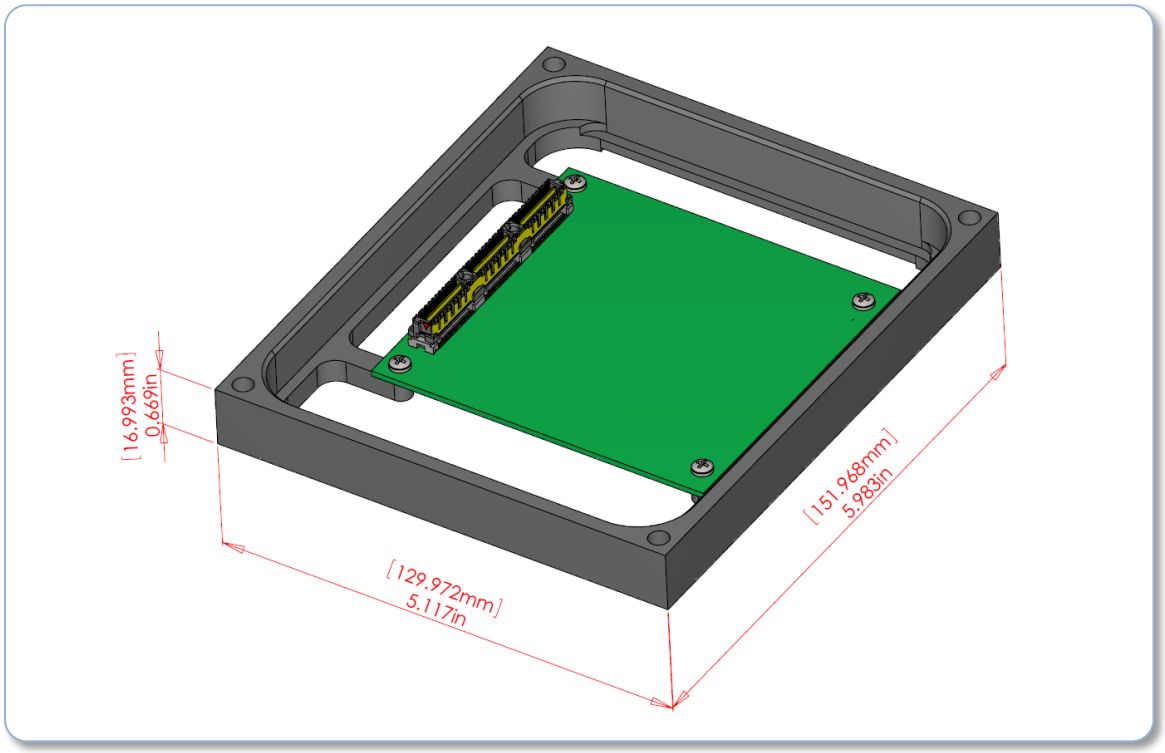
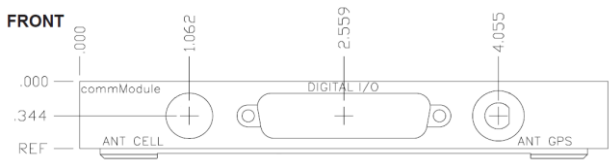


Figure 5: IDAN Dimensions

4.3 Connectors

4.3.1 External I/O Connectors

Digital I/O Connector

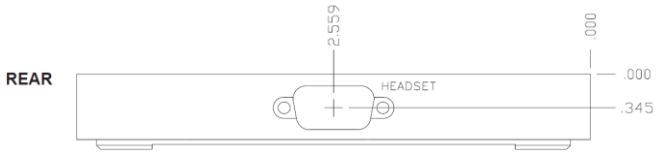


Connector Part #: Amp 747913-2 **Sample Mating Connector:** Amp 3-1740199-2

Table 8: IDAN- COM16155 25-Pin Subminiature "D" Connector

IDAN Pin#	Signal	DM35425 Pin #	
1	GND	CN8	1
2	DIO1	CN8	3
3	DIO3	CN8	5
4	DIO5	CN8	7
5	DIO7	CN8	9
6	GND	CN8	11
7	DIO9	CN8	13
8	DIO11	CN8	15
9	DIO13	CN8	17
10	DIO15	CN8	19
11	DIO0/1PPS	CN8	2
12	DIO2	CN8	4
13	DIO4	CN8	6
4	DIO6	CN8	8
15	+5V	CN8	10
16	DIO8	CN8	12
17	DIO10	CN8	14
18	DIO12	CN8	16
19	DIO14	CN8	18
20	+5V	CN8	20
21	*Reserved*		
22	*Reserved*		
23	*Reserved*		
24	*Reserved*		
25	*Reserved*		

Headset Connector



Connector Part #: Amp 5747150-8 **Sample Mating Connector:** Amp 747515-7

Table 9: IDAN- COM16155 9-Pin Subminiature "D" Connector

IDAN Pin#	Signal	DM35425 Pin #	
1	GND	CN7	1
2	MICN	CN7	3
3	EPN	CN7	5
4	VMICN	CN7	7
5	Reserved	CN7	9
6	MICP	CN7	2
7	EPP	CN7	4
8	VMICP	CN7	6
9	Reserved	CN7	8

4.4 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the IDAN system.
3. Remove the module from its anti-static bag.
4. Check that pins of the bus connector are properly positioned.
5. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
6. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
7. Gently and evenly press the module onto the IDAN system.
8. If any boards are to be stacked above this module, install them.
9. Finish assembling the IDAN stack by installing screws of an appropriate length.
10. Attach any necessary cables to the IDAN system.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

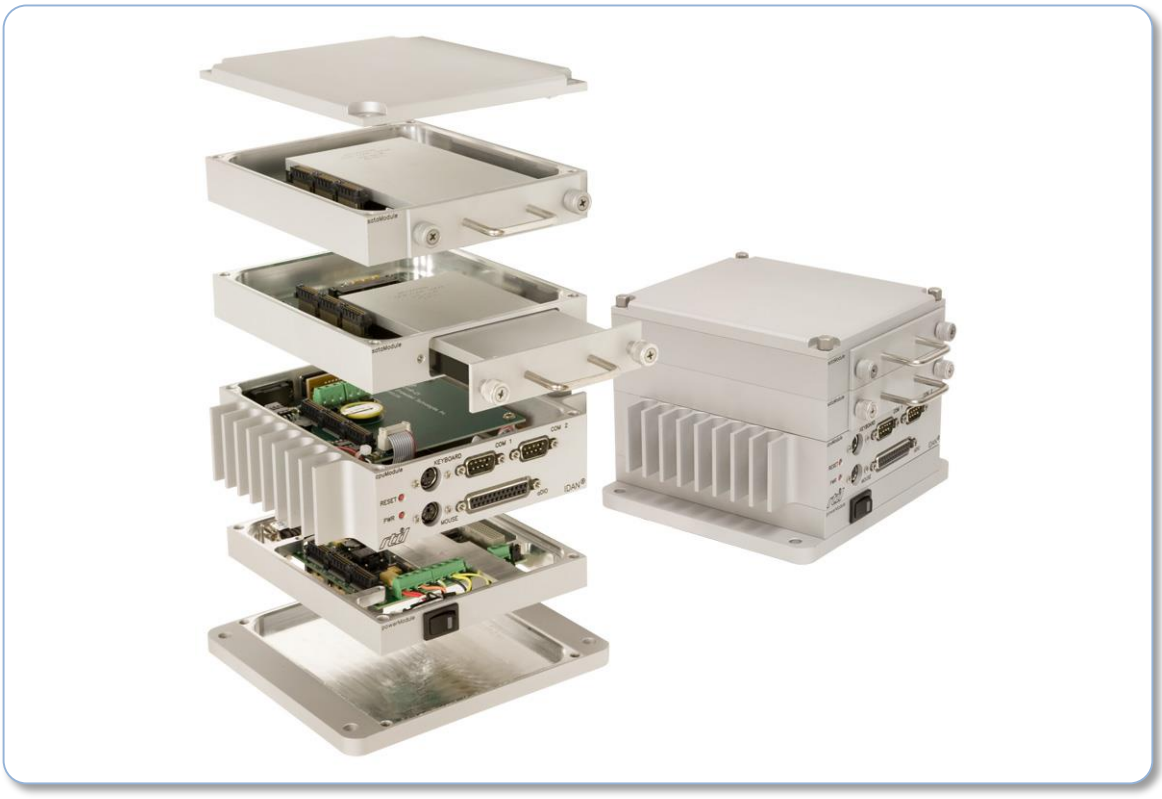


Figure 6: Example IDAN System

5 Functional Description

5.1 Block Diagram

The Figure below shows the functional block diagram of the COM16115. The various parts of the block diagram are discussed in the following sections.

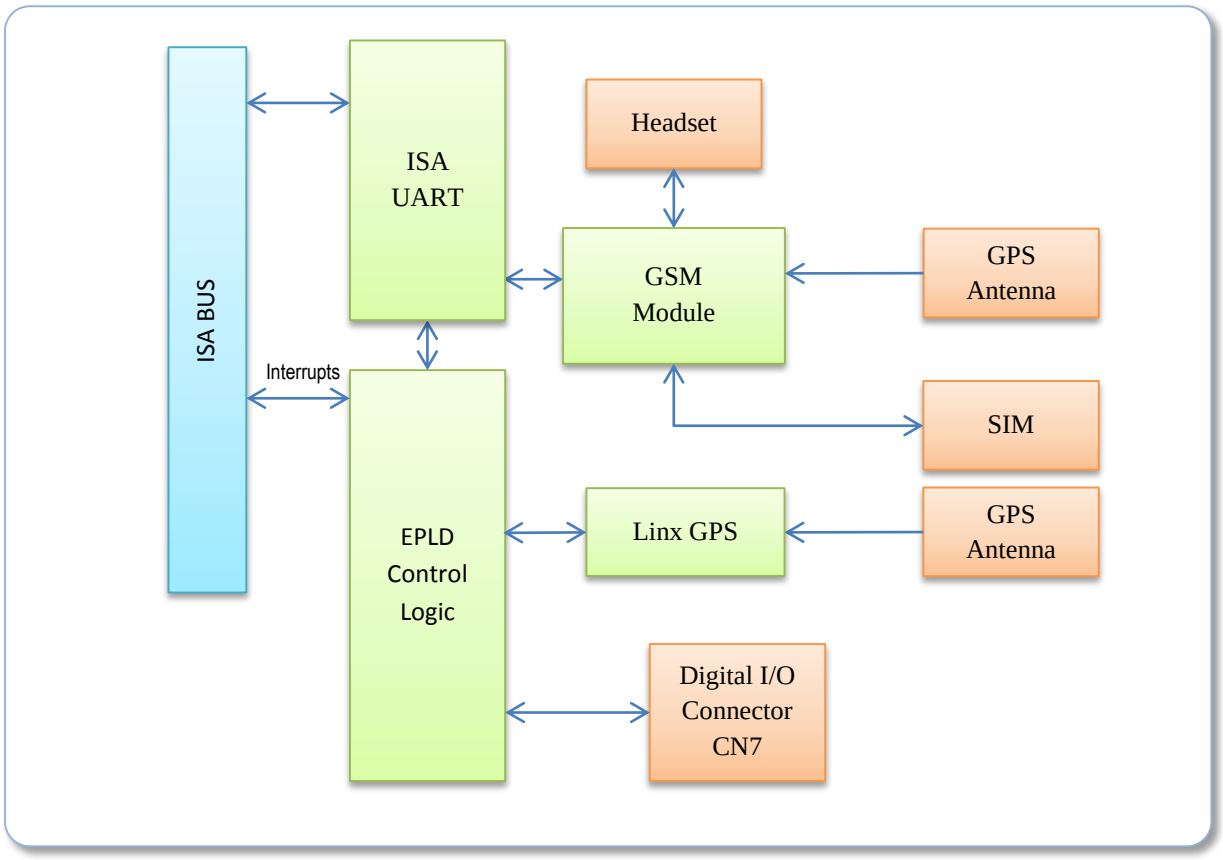


Figure 7: COM16155 Block Diagram

5.1.1 Cinterion MC55i-W Quad-Band Cellular Engine (COM16155ER)

The COM16155 wireless GPRS/GSM modem is built around the Cinterion MC55i-W quad-band 850/900/1800/1900 MHz GPRS cellular engine. It is designed both for handling complex industrial applications such as telemetry, telematics or communication, and for integration in stationary or mobile fields all over the world.

The COM16155 is capable of powerful communication using GSM data interfacing. GPRS data rates can reach up to 85.6 kbit/s max downlink depending on the network capacity and the network load. Engineers must take into account that GPRS data rates will vary dynamically depending on network conditions. This must be considered when designing software and system specifications. Roaming agreements and GPRS data support may not in all cases be available when moving from country to country. Check with your local network provider for GPRS coverage.

The COM16155 is capable of FAX and standard SMS text messages. The data terminal rate is 9600 baud for all host commands (AT commands). The COM16155 modem module antenna interface connector uses an OSX connector. The mating antenna connectors and cables are supplied by RTD.

Note:	The Cinterion MC55i-W module has two serial ports, labeled ASC0 and ASC1. However, only port ASC0 is available for use on the COM16155.

MC55i-W Module Interface

The COM16155 GPRS/GSM modem is connected to the host computer through dedicated ISA serial port. The first serial port is connected to GSM ASC0. The default configuration for the GSM serial ports is:

GSM Interface

- 9600 baud
- 8 data bits
- No parity
- 1 stop bit

The modem can also connect through the USB interface. Simply load the USB driver and connect the USB to the USB port on your host computer.

GSM Antenna Considerations

Typically standard GSM antennas use a female FME connector. This connector needs an adapter unit before it can be connected to the COM16155.

RTD recommends the use of high quality antennas with the COM16155. We have tested successfully with antennas from Hirschmann Rheinmetall Elektronik.

Visit http://www.hirschmann.de/ for information on GSM antennae.

A very useful AT command that shows quality of the signal reception is: AT+CSQ. The format of the response is AT+CSQ: received signal strength, bit error rate. The received signal strength shows the quality of the network signal and ranges from 0 to 31 as shown in the table below. A value of greater than 10 should give an acceptable connection. The bit error rate number will range between 0 and 7.

Table 10: Received Signal Strength Values

99 = undetectable signal							
0	- 113 dBm	8	- 97 dBm	16	- 81 dBm	24	- 65 dBm
1	- 111 dBm	9	- 95 dBm	17	- 79 dBm	25	- 63 dBm
2	- 109 dBm	10	- 93 dBm	18	- 77 dBm	26	- 61 dBm
3	- 107 dBm	11	- 91 dBm	19	- 75 dBm	27	- 59 dBm
4	- 105 dBm	21	- 89 dBm	20	- 73 dBm	28	- 57 dBm
5	- 103 dBm	13	- 87 dBm	21	- 71 dBm	29	- 55 dBm
6	- 101 dBm	14	- 85 dBm	22	- 69 dBm	30	- 53 dBm
7	- 99 dBm	15	- 83 dBm	23	- 67 dBm	31	=> - 51 dBm

SIM-Card Reader

Standard 3V and 1.8V SIM-cards can be used with the COM16155. Older 5V SIM cards will not work, though they may operate in standard GSM cellular phones. The SIM-card holder has a card detection circuit that will in theory allow removal of the card. This is **NOT** recommended, since the SIM card contents can become corrupted if it is removed while the MC55i-W GSM modem is writing to it.

LED D1 will turn on when a SIM card is enabled.

A very useful AT command that shows detection of the SIM card is: **AT^SCID**. The SIM card identifier is given as a reply **^SCID: value** shows the ID of the SIM card. If no ID is detected the MC55i-W cannot read the SIM card and cannot connect to the GSM service provider network.

To add an entry to your SIM card you may use the AT+CPBW command. In this example we add the RTD phone number +1-814-234-8087 to the SIM card memory location "1" with the following AT command set:

AT+CPBW=1, 18142348087, 145, RTD

AT+CREG? Will indicate if the COM16155 is logged into the network. If the reply for example is **+CREG: 0, 1** it means that connection to the home network is valid. A complete AT-instruction set documentation is included in the MC55i-W user's manual.

5.1.2 LINX RXM-GNSS-TM GPS RECEIVER

Integrated on the COM16155 is a Linx RXM-GNSS-TX, a low power fast-fix 33-channel GPS receiver. This GPS receiver is especially designed for portable and mobile applications. The Linx RXM-GNSS-TM provides NMEA-0183 version 4.10 data and a 1 PPS signal.

A complete list of NMEA Messages and command messages is available from the manufacturer's website at www.linxtechnologies.com.

GPS module interface

The RXM-GNSS-TM GPS is connected to the host computer through a dedicated ISA serial port. Carrier Detect of the serial port is driven by the 1 PPS signal. The default configuration for the serial ports is:

- 9600 Baud
- 8 Data bits
- No parity
- 1 Stop bit
- No Flow Control

GPS Antenna

Most GPS antennas are "active" which means they have a low noise amplifier (LNA) built into the antenna that requires a power source for the GPS module. While the COM16155 will work with a passive antenna, better performance will be achieved with an active antenna. COM16155 provides +5 V or +3.3 V for active GPS antennas.

5.1.3 DIGITAL I/O

The COM16155 has 16 bit-programmable digital I/O bits. JP4 controls a 10K Ohm pull up/down on DIO bits 1-8 and JP5 controls a 10K Ohm pull up/down on DIO bits 9 -16.

JP3 selects if DIO0, CN7-2, is digital I/O or the GPS 1 pulse-per-second. JP3 (1-2) is installed by default configuring DIO0 as digital I/O. If JP3 is set to 2-3, the GPS 1 pulse-per-second is driven out DIO0.

6 Register Address Space

This chapter shows you how to program and use your COM16155. It provides a general description of the I/O map.

6.1 General Board Control

The memory map of the COM16155 occupies two groups of eight bytes of host PC I/O space. This window is freely selectable by the user by jumpers JP6 for GPS BASE and JP7 for the GSM BASE. After setting the base address you have access to the internal resources of the COM16155 control logic. The board also has 16 digital I/O lines that can be accessed several ways.

Table 11: Register Map

ADDRESS (hex)	REGISTER	DIRECTION	COMMENTS
GSM BASE + 0	TXD	Read	Standard 16C550 UART Registers
	RXD	Write	
	BAUD div. Low	Read/Write	
GSM BASE + 1	BAUD div. Low	Read/Write	
	IRQ enable	Read/Write	
GSM BASE + 2	IRQ ID	Read/Write	
GSM BASE + 3	Line control	Read/Write	
GSM BASE + 4	Modem control	Read/Write	
GSM BASE + 5	Line status	Read	
GSM BASE + 6	Modem status	Read	
GSM BASE + 400h	Digital I/O	Read/Write	COM17045 compatibility DIO
GSM BASE + 401h	*Reserved*		
GSM BASE + 402h	GSM Status	Read/Write	Configuration Registers
GSM BASE + 403h	GSM Control	Read/Write	Power Control
GSM BASE + 404h	Digital I/O	Read/Write	Digital I/O bits 0-7
GSM BASE + 405h	Digital I/O	Read/Write	Digital I/O bits 8-15
GSM BASE + 406h	Digital I/O Direction	Read/Write	Digital I/O direction bits 0-7
GSM BASE + 407h	Digital I/O Direction	Read/Write	Digital I/O direction bits 8-15
GSM BASE + 800h	RTD ID Data	Read	Read next RTD ID Character
GSM BASE + 801h	RTD ID Data	Read	Read next RTD ID Character
GSM BASE + 802h	Reset RTD ID	Read	Reset RTD ID counter

Table 12: Register Map

ADDRESS (hex)	REGISTER	DIRECTION	COMMENTS
GPS BASE + 0	TXD	Read	Standard 16C550 UART Registers
	RXD	Write	
	BAUD div. Low	Read/Write	
GPS BASE + 1	BAUD div. Low	Read/Write	
	IRQ enable	Read/Write	
GPS BASE + 2	IRQ ID	Read/Write	
GPS BASE + 3	Line control	Read/Write	
GPS BASE + 4	Modem control	Read/Write	
GPS BASE + 5	Line status	Read	
GPS BASE + 6	Modem status	Read	
GPS BASE + 400h	Digital I/O	Read/Write	COM17045 compatibility DIO
GPS BASE + 401h	GPS Status	Read/Write	Configuration registers
GPS BASE + 402h	*Reserved*		
GPS BASE + 403h	*Reserved*		
GPS BASE + 404h	Digital I/O	Read/Write	Digital I/O bits 0-7
GPS BASE + 405h	Digital I/O	Read/Write	Digital I/O bits 8-15
GPS BASE + 406h	Digital I/O Direction	Read/Write	Digital I/O direction bits 0-7
GPS BASE + 407h	Digital I/O Direction	Read/Write	Digital I/O direction bits 8-15
GPS BASE + 800h	RTD ID Data	Read	Read next RTD ID Character
GPS BASE + 801h	RTD ID Data	Read	Read next RTD ID Character
GPS BASE + 802h	Reset RTD ID	Read	Reset RTD ID counter

6.1.1 UART I/O (GPS/GSM BASE + 0 TO GPS/GSM BASE + 7)

These are the UART registers for the GPS/GSM module. These resources are not described in detail, since they are mapped as a standard PC serial port. For more details on the EXAR 16C550 UART chip programming please download the component specific data from the website: http://www.exar.com.

6.1.2 GSM STATUS (GSM BASE +402H)

Table 13: GSM STATUS (GSM BASE + 402h)
Default: 0x00

BIT	FUNCTION	DIRECTION	COMMENTS
Bit 0	/EN_RST	Read	0 – GSM active 1 – Reset GSM in reset
Bit 1	/EN_INT	Read/Write	GSM interrupt enabled 1- disabled
Bit 2	TEMP_LOW	Read	1 – Board temperature below -20C
Bit 3	TEMP_HIGH	Read	1 – Board temperature over +70C
Bit 4	*Reserved*		
Bit 5	*Reserved*		
Bit 6	*Reserved*		
Bit 7	*Reserved*		

6.1.3 GSM CONTROL (GSM BASE +403H)

Table 14: GSM Control (GSM BASE + 403h)
Default: 0x00

BIT	FUNCTION	DIRECTION	COMMENTS
Bit 0	Ignition Signal	Read/Write	State of Ignition 1 -> 0 – Results in IGN signal
Bit 1	Power down	Read/Write	0 – Power On 1 – Power Down
Bit 2	*Reserved*		
Bit 3	*Reserved*		
Bit 4	*Reserved*		
Bit 5	*Reserved*		
Bit 6	*Reserved*		
Bit 7	*Reserved*		

6.1.4 GPS STATUS (GPS BASE + 401H)

Table 15: GPS STATUS (GPS BASE + 401h)
Default: 0x00

BIT	FUNCTION	DIRECTION	COMMENTS
Bit 0	*Reserved*		
Bit 1	*Reserved*		
Bit 2	*Reserved*		
Bit 3	/EN_INT	Read/Write	0 = GPS interrupts enabled 1 = Disabled
Bit 4	*Reserved*		
Bit 5	*Reserved*		
Bit 6	1PPS/DIO 0	Read/Write	0 = DIO 0 1 = 1PPS
Bit 7	1 PPS	Read	1 PPS from GPS

Note: To output 1 PPS out DIO0, DIO0 direction needs set to an output.

6.1.5 DIGITAL I/O

COM16155 allows bit programmable direction for all digital I/O bits. COM17045 compatibility is described later. Note the digital I/O registers are accessed at 404h – 407h above the GPS/GSM COM port. These addresses are used to interface to the digital I/O port. The 16 bits each have a direction bit. If the direction bit is set to output, a value written to the data bit is provided on the connector. A read will result in the value on the connector pin (i.e. the output value). If the direction is set to input, a value written to the data bit is ignored and a read will result in the value on the connector pin.

Table 16: Digital I/O Data (GPS/GSM BASE + 404h)
Default: 0x00

BIT	FUNCTION	DIRECTION
Bit 0	DIO0	CN8 Pin 2
Bit 1	DIO1	CN8 Pin 3
Bit 2	DIO2	CN8 Pin 4
Bit 3	DIO3	CN8 Pin 5
Bit 4	DIO4	CN8 Pin 6
Bit 5	DIO5	CN8 Pin 7
Bit 6	DIO6	CN8 Pin 8
Bit 7	DIO7	CN8 Pin 9

Table 17: Digital I/O Data (GPS/GSM BASE + 405h)
Default: 0x00

BIT	FUNCTION	DIRECTION
Bit 0	DIO8	CN8 Pin 12
Bit 1	DIO9	CN8 Pin 13
Bit 2	DIO10	CN8 Pin 14
Bit 3	DIO11	CN8 Pin 15
Bit 4	DIO12	CN8 Pin 16
Bit 5	DIO13	CN8 Pin 17
Bit 6	DIO14	CN8 Pin 18
Bit 7	DIO15	CN8 Pin 19

Table 18: Digital I/O Direction (GPS/GSM BASE + 406h)
Default: 0xFF

BIT	FUNCTION	DIRECTION
Bit 0	DIO0	0 = INPUT 1 = OUTPUT
Bit 1	DIO1	0 = INPUT 1 = OUTPUT
Bit 2	DIO2	0 = INPUT 1 = OUTPUT
Bit 3	DIO3	0 = INPUT 1 = OUTPUT
Bit 4	DIO4	0 = INPUT 1 = OUTPUT
Bit 5	DIO5	0 = INPUT 1 = OUTPUT
Bit 6	DIO6	0 = INPUT 1 = OUTPUT
Bit 7	DIO7	0 = INPUT 1 = OUTPUT

Table 19: Digital I/O Direction (GPS/GSM BASE + 407h)
Default: 0x00

BIT	FUNCTION	DIRECTION
Bit 0	DIO8	0 = INPUT 1 = OUTPUT
Bit 1	DIO9	0 = INPUT 1 = OUTPUT
Bit 2	DIO10	0 = INPUT 1 = OUTPUT
Bit 3	DIO11	0 = INPUT 1 = OUTPUT
Bit 4	DIO12	0 = INPUT 1 = OUTPUT
Bit 5	DIO13	0 = INPUT 1 = OUTPUT
Bit 6	DIO14	0 = INPUT 1 = OUTPUT
Bit 7	DIO15	0 = INPUT 1 = OUTPUT

6.1.6 RTD ISA ID

RTD ID is a method to identify a board on the ISA bus. There are two 8-bit registers mapped at **BA + 800h** and **BA + 801h**. The registers can be read as two 8-bit or one 16-bit. An internal pointer is auto-incremented with every read to either address so the data read will step through each index as indicated below. The pointer is set to zero at reset and can be reset to zero by a read to **BA + 802h**.

Table 20: RTD ID DATA READ Indexes

Index	Data	8-Bit Read	16-Bit Read
0	Device ID	55h	6155h
1	Device ID	61h	—
2	RTD Vendor ID	35h	1435h
3	RTD Vendor ID	14h	—
4	EPLD Revision	Revision LSD	Revision
5	EPLD Revision	Revision MSD	—
6–9	Reserved	Ignore	Ignore
10	Board Name String	C	CO
11	Board Name String	O	—
12	Board Name String	M	M1

Table 20: RTD ID DATA READ Indexes

Index	Data	8-Bit Read	16-Bit Read
13	Board Name String	1	—
14	Board Name String	6	61
15	Board Name String	1	—
16		5	55
17		5	—
18	Board Name String	<nul>	<nul><nul>
19	Board Name String	<nul>	—
20–255	Unused	FFh	FFFFh

6.2 COM17045 Compatibility

This register is intended only for COM17045 compatibility. This address is used to interface to the digital I/O port of the COM16155. Writing to this address will transfer the data to the output port, while reading from this address will return the data from the digital inputs. This register is compatible with the COM17045 module. Note the default direction of the 16 digital I/O bits is bits 0 - 7 are outputs and 8 - 15 are inputs. Note: If you change the direction registers from the default, then this register will not operate properly.

Table 21: Digital I/O Data (GPS BASE + 400h) Write

BIT	FUNCTION	DIRECTION
Bit 0	Output 0	CN8 Pin 2
Bit 1	Output 1	CN8 Pin 3
Bit 2	Output 2	CN8 Pin 4
Bit 3	Output 3	CN8 Pin 5
Bit 4	Output 4	CN8 Pin 6
Bit 5	Output 5	CN8 Pin 7
Bit 6	Output 6	CN8 Pin 8
Bit 7	Output 7	CN8 Pin 9

Table 22: Digital I/O Data (GPS BASE + 400h) Read

BIT	FUNCTION	DIRECTION
Bit 0	Input 0	CN8 Pin 12
Bit 1	Input 1	CN8 Pin 13
Bit 2	Input 2	CN8 Pin 14
Bit 3	Input 3	CN8 Pin 15
Bit 4	Input 4	CN8 Pin 16
Bit 5	Input 5	CN8 Pin 17
Bit 6	Input 6	CN8 Pin 18
Bit 7	Input 7	CN8 Pin 19

6.3 Using the GSM Engine

The GSM engine is controlled via the industry-standard ASCII 'AT' command set. A user can operate the GSM simply by sending it command strings from a terminal emulator program (e.g. Windows HyperTerminal).

The complete list of AT command strings supported by the MC55i-W are described in a document provided by Cinterion. Refer to the Additional Information section of this manual for more information.

6.3.1 Starting up and logging into the GSM network

With no power applied insert your +3V or dual voltage SIM into the card- holder on the solder side of the board. Connect the antenna cable to the MC55i-W antenna connector and power up your PC/104 system. The COM16155 will be initialized by the system. After this the status LED will blink for a while until the MC55i-W is logged into the network. If you have the PIN code enabled, the COM16155 status LED will continue to blink until the PIN code is given through the terminal mode with AT command **AT+CPIN"XXXX"**, unless **AT^SFLC** (facility lock for PIN code) has been set. Once the COM16155 is logged onto the network the LED will be lit continuously.

6.3.2 Using SMS

The SMS features of the Cinterion MC55i-W are controlled by AT command strings. The Cinterion documentation covers these commands in depth.

7 Troubleshooting

If you are having problems with your system, please try the following initial steps:

- **Simplify the System** – Remove modules one at a time from your system to see if there is a specific module that is causing a problem. Perform you troubleshooting with the least number of modules in the system possible.

- **Swap Components** – Try replacing parts in the system one at a time with similar parts to determine if a part is faulty or if a type of part is configured incorrectly.

If problems persist, or you have questions about configuring this product, contact RTD Embedded Technologies via the following methods:

Phone: +1-814-234-8087
E-Mail: techsupport@rtd.com

Be sure to check the RTD web site (http://www.rtd.com) frequently for product updates, including newer versions of the board manual and application software.

7.1 Common Problems and Solutions

Table 23 lists some of the common problems you may encounter while using your COM16155 and suggests possible solutions.

If you are having problems with your GPS module, review this table before contacting RTD Technical Support.

Table 23: Troubleshooting

Problem	Possible Cause
Erratic mouse cursor behavior under Windows	The COM16155 may have been detected as a serial mouse. Refer to Microsoft Knowledge Base Article 283063 for more information.

8 Additional Information

8.1 PC/104 Specifications

A copy of the latest PC/104 specifications can be found on the webpage for the PC/104 Embedded Consortium:

www.pc104.org

8.2 Linx RXM-GNSS-TM

For a downloadable datasheet of RXM-GNSS-TM visit Linx's webpage:

www.linxtechnologies.com

8.3 Cinterion MC55i Cellular Engine

For more information on the Cinterion module, including a list of the supported AT command, contact Cinterion:

http://www.Cinterion.com

9 Limited Warranty

RTD Embedded Technologies, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from RTD Embedded Technologies, Inc. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, RTD Embedded Technologies will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to RTD Embedded Technologies. All replaced parts and products become the property of RTD Embedded Technologies. Before returning any product for repair, customers are required to contact the factory for a Return Material Authorization (RMA) number.

This limited warranty does not extend to any products which have been damaged as a result of accident, misuse, abuse (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by RTD Embedded Technologies, “acts of God” or other contingencies beyond the control of RTD Embedded Technologies), or as a result of service or modification by anyone other than RTD Embedded Technologies. Except as expressly set forth above, no other warranties are expressed or implied, including, but not limited to, any implied warranties of merchantability and fitness for a particular purpose, and RTD Embedded Technologies expressly disclaims all warranties not stated herein. All implied warranties, including implied warranties for merchantability and fitness for a particular purpose, are limited to the duration of this warranty. In the event the product is not free from defects as warranted above, the purchaser's sole remedy shall be repair or replacement as provided above. Under no circumstances will RTD Embedded Technologies be liable to the purchaser or any user for any damages, including any incidental or consequential damages, expenses, lost profits, lost savings, or other damages arising out of the use or inability to use the product.

Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, and some states do not allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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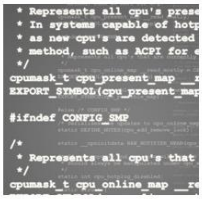

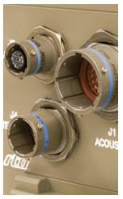
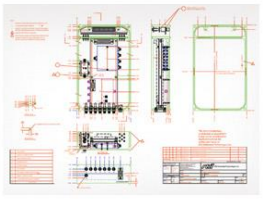

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